Fires and Maneuver Supporting Focus Area

Philosophy

The Lab is focused on exploring capabilities that will permit the seabased Marine expeditionary forces to conduct future maneuver warfare operations fully employing the precision fires, highly mobile indirect fire systems, and vehicles that will be internally transportable in future helicopters and tilt-rotor aircraft.

Fires and maneuver technology development is primarily focused on (1) precision target location for delivery of accurate fires, (2) development of a viable mobile fire support system for the support of the air delivered ground combat force during Ship-to-Objective-Maneuver (STOM), (3) the development of internally transportable ground combat vehicles within helicopters and MV-22, and (4) the development of effective mine counter measures for the maneuver forces.

Background

The Lab has been investigating and experimenting with technology solutions to address improvements to fire support to, among other things, improve precision, terminal effects, responsiveness, and mobility. A focus of effort has been to address the unique requirements of fire support in respect to *Expeditionary Maneuver Warfare (EMW)* and specifically (STOM) as well as the subset of *Military Operations In Urban Terrain* (MOUT). EMW/STOM operations have several unique challenges, beyond those posed by conventional operations, because of the distances traveled by the littoral penetration force and the initial isolation of those first elements.

As first demonstrated in the *Hunter Warrior* Advanced Warfighting Experiment (AWE) in 1997, the key fire support for a EMW/STOM force must be sited with that STOM force to ensure responsiveness in all situations. Long times of flight and/or processing reduced the effectiveness of fire and all but eliminated the attack of fleeting and mobile enemy targets. High volume of fire requirements, such as preparation fires, final protective fires, etc., could not be addressed using sea-based fires beyond the basic 30 km maximum range of conventional 5-inch caliber naval surface fires.

Any system accompanying the STOM force must be sized to fit within the envelope of the MV-22 Osprey or helicopters and the logistic support, that is the ammunition for those weapons, must represent the optimum effects available per shot for the most efficient volumetric and weight package per sling load/cargo bay/truck bed. During this same AWE, the marked improvement in precision targeting devices proved to be a decisive factor in the prompt engagement of mobile enemy targets. Even though these first-generation systems were bulky and complex, significant gains in target identification, acquisition, and fire mission transmission speed materially improved the combat effectiveness of the STOM elements.

During *Urban Warrior,* the focus was on combat in the urban environment and very precise targeting, fast response times, and tailored effects of those fires moved to the forefront. The targeting required precision in the vicinity of a few meters with an exact target altitude to ensure that weapons engaged the exact room being targeted and would not kill friendly forces or noncombatants in close proximity. Tailored effects were modeled to focus the lethal or less than lethal effects on the target and not cause damage that would threaten or impede the MAGTF mission. Fires coordination experimentation only began to touch on the complexity of allocating, adjudicating, and deconflicting fires and flight paths in the compressed three-dimensional space above and within the city.

Urban Warrior demonstrated that once again, combat within a city is exceptionally close-coupled, vertical as well as planar, and extremely dangerous. New directions in technology will be required to offset an enemy's advantages and reduce the MAGTF's casualties by using supporting arms within the walls of the "urban canyon".

Based on experimentation results and the lessons learned from Limited Technical Assessments (LTAs), it is clear that the continued evolution of fire support to support EMW/STOM and urban operations, as well as more convention combat scenarios, entails continued technological development and experimentation in the following directions:

Responsiveness. All forms of fire support need to be delivered as quickly as possible to ensure the destruction of key enemy strengths and offsetting the relative vulnerability of the lead elements of an EMW/STOM force. The more quickly a target is struck, the more likely the threat will be neutralized and the more effectively that threat is removed from the path of the EMW/STOM force. In the case of mobile targets, fast response times are essential: enemy forces can quickly overwhelm or escape the MAGTF if they cannot be attacked quickly.

Precision. Striking an enemy target with the first round fired is an achievable ideal and an essential requirement for a force with limited logistic access. This precision requires accurate target location by ground observers, Unmanned Arial Vehicles (UAVs), and other elements of the Reconnaissance, Surveillance, Target Acquisition (RSTA) Grid, then state-of-the-art technical fire direction flight path prediction that incorporates real-time meteorological data, velocity variances, experience-based data and other techniques to dependably place projectiles close enough to neutralize or destroy a target on the first shot. In addition to improving the effectiveness of fires against the targets engaged, this will also allow greater depth of engagement against detected enemy forces, extending the *reach* of EMW/STOM elements while reducing the logistic loads required to effectively support our forces in long distance operations.

Flexibility. Supporting the EMW/STOM maneuver forces requires systems and weapons effects that can accommodate the wide range of terrain, weather and tactics that will be encountered. The initial entry forces of the STOM force will be constrained to work within the envelope of the interior of the MV-22 Osprey or helicopters which is to say, they must be very compact and light.

Fire support systems that are designed to conform to these specifications must be able to be upgraded with the addition of modules to adopt new characteristics and capabilities as the EMW/STOM force transitions to a mobile maneuver force. The effects delivered must be able to confront all types of target in any feasible environment, such as reduced effects when supporting an urban attack, or the ability to defeat field fortifications or light armor or penetrate heavy vegetation cover in addition to the conventional *infantry in the open* type of targets.

Mobility. Ground combat forces transported by air must have internally transportable fire support systems and selected vehicles for ground transportation. External lifts, while adequate for short distance movements, cannot be used for long distance STOM operations. Aircraft that are carrying an external load are constrained by slow speed, excessive fuel use, and vulnerability. Over 100 nautical miles, the penalties posed by external loads make it impossible to carry any meaningful load in that manner. Once the force is on the ground, fire support systems must be able to move at the same speed and over the same terrain as the maneuver force. Once the STOM force has transitioned to a conventional mobile force, then the fire support systems must be able to transition to the same mobility.

Logistic Supportability. Ground fire support is a function of delivery means positioning, range, rate of fire, and ammunition flow. Ammunition flow depends on the means available for movement ashore, surface transportation and roads available, airlift assets and approach lanes available and in the case of larger caliber weapons, the availability of materiel handling equipment at the firing positions. Like the flow of fuel to an engine, ammunition movement determines the tempo of the weapon rates of fire and the amount of fire support effects available for influencing the direction of the battle.

These and other areas were shown to be deficient in the context of these warfighting experiments and these deficiencies and the work of the Operational Maneuver From the Sea (OMFTS) Working Group have helped guide the Lab to pursue directions to address these deficiencies.

TECHNOLOGICAL DEVELOPMENTS

Precision Targeting. The first technological direction has been to continue to develop the technologies for precision targeting systems. Observers have been hampered by equipment that has been either primitive or heavy, complex, troublesome and often inaccurate. The first prototype precision targeting systems also had difficulty communicating the fire missions through legacy fire support coordination systems and the potential gains in responsiveness were lost through these interruptions.

The Lab has experimented with several competing eye-safe laser range finding systems that were incorporated into the Forward Observer/Forward Air Controller (FO/FAC) system to allow direct transmission of fire missions to fire direction/fire support coordination systems. The Lab has also experimented with UAV-borne precision targeting systems using the *Dragon Drone* UAV as a platform, as well as the Airborne Target Acquisition (ATA) system developed by the Naval Surface Warfare Center at Dahlgren. These experiments demonstrated that precision-targeting devices could lead to a leap-ahead capability for the attack of enemy targets and greatly facilitates accurate employment of supporting arms. The main technological/engineering impediments to fielding next generation precision targeting systems are:

Weight. Several of the available targeting systems weigh between 30 and 45 pounds, less radios, and limit the mobility of ground observers.

Complexity. Several precision targeting systems require multiple connection cables, batteries, and modules to function. Additionally, many of the prototype systems have complex programs that require completing successive data entries to complete the preparation of a fire mission.

These complex systems require time to process a fire mission and a high level of training for observers to employ them. One observed effect has been the tendency of the developers of precision targeting software to make the observer provide the maximum amount of data – such as the detailed description of targets – to facilitate the decision-making software at the fire support coordination centers. This has had the effect of increasing observer data entry requirements and reducing fire mission responsiveness.

Location Errors. Most or all of the available precision targeting devices use a magnetic compass for target direction. These compasses introduce an error of 15 mils or more, even if the compass is properly declinated for its surroundings. This error can equate to at least 75 meters at 5,000 meters. The use of newly designed miniature gyros can provide much greater directional accuracy and reduce these errors.

Communication. Systems developed to work with some fire support coordination software systems will not work with others. The message address formats in present use are being supplanted at some future date by a new joint format system, which is not yet available. This has had the effect of constraining the development of any new systems until the new formats are defined.

Fires Adjudication/Fires Allocation. This arena of fire support coordination has been the most difficult technological challenge of the sensor-to-shooter chain for EMW/STOM. These types of systems facilitate target attack to support the commander's intent for the scheme of maneuver and to choose and allocate fires based on the basic priority system. None of the systems used – legacy or new technology – can adequately merge air fires and naval surface fires and ground fires. During experiments, multiple systems have been required to coordinate the different elements of fire support.

Experiments have also demonstrated the reduced *footprint* of employing this or similar systems, since there is no requirement for additional communications, fire direction, or survey teams required to support firing operations.

Another series of experiments with air-delivered fires in urban operations, the Aviation LTA at Yuma, Arizona, demonstrated the effectiveness and state of development of precision air-delivered fires in a MOUT environment and laid out the directions for further development and experimentation. The main areas of further development were:

Precision targeting. As with ground-based fires, precise location of targets in three dimensions is critical to the effective employment of air-delivered fires in MOUT.

Laser Designation Systems. This capability is key to precision attack with laser-guided weapon systems and the lasers were shown to be ineffective during the employment of obscuration.

Scalable-Yield Weapons. Air-delivered weapons are the most powerful supporting arms available in our inventories. In many cases during urban combat, the larger of these weapons would be constrained from use because of the danger to friendly forces and noncombatants in close proximity and the excessive rubble it created. A scalable yield system to give weapons that were usable in close combat within a city was shown to be needed.

PRECISION TARGETING

The Advanced Target Handoff System (ATHS (X)) combines the Litton MELIOS laser rangefinder with the combined arms targeting software in the Ruggedized Handheld Computer (RHC) and a small tactical radio to provide a lightweight and accurate targeting system for air, naval, artillery fires. This system is designed for minimum steps to prepare a fire mission, using defaults to simplify and speed the handoff of a target to a fire support agency for attack. This system allows an observer to accurately target out to 10,000M and process air, naval, and ground fire missions interchangeably and simultaneously.

Exploiting the color map projection, aircraft tracking, internal Global Positioning System (GPS) card, communication with ATHS-equipped AV-8B aircraft, and full nine-line generation capability of the ATHS (X), an observer can simultaneously control a close air support mission while firing artillery, mortars or naval surface fires against targets.

Upgraded UAV Targeting System. Continuing with the development work initiated with the Dragon Drone targeting system and the ATA system, a new generation UAV targeting system, which allows target acquisition using a Synthetic Aperture Radar (SAR), is being proposed. The SAR system prototype was tested in an LTA taking place at Yuma AZ during summer 2001. At the same time, a new system to relay targets from the UAV to other systems is being tested in an LTA. This capability would allow the *Dragon Warrior* UAV and others to relay targets to aircraft, fires coordination centers or the weapon itself. To upgrade the precision of the UAV targeting system, a geolocation system is being examined that would allow the UAV targeting system to calibrate its targeting system by aiming at known geographic points.

The Expeditionary Fire Support System (EFSS)

One of the more controversial concepts explored during the Hunter Warrior AWE was the employment of helicopter internally transportable 120mm mortar systems that once on the ground could be operated remotely and autonomously by infantry squads using a modified electronic "PIN" system.

Subsequently, the Marine Corps developed a more refined concept called the EFSS to provide a highly mobile indirect fire support system that could be internally helicopter and MV-22 transported and provide a fire support system once off-loaded with the same mobility as that of the force it supports. The Marine Corps is currently exploring alternative systems to meet the EFFS requirement with an objective of initial operational capability during FY06.

The Lab has conducted a series of experiments with a 120mm rifles, automated mortar system known as the *Dragon Fire* which has demonstrated many of the capabilities called for in the EFSS Mission Need Statement (MNS) and can form the basis for the new EFSS.

In the *Dragon Fire* the functions of communication, power movement of the firing elements and loading systems and automated fire control, and precise positioning and pointing systems were combined to reduce response time and increase accuracy in a medium-caliber, medium-range system. In addition, this system is internally transportable within MV-22 Osprey aircraft.

The Expeditionary Fires Technology Demonstrator, Version 2 (EFTD V2). In cooperation with the Office of Naval Research, Future Naval Capabilities the lab is working to develop the next-generation version of the *Dragon Fire*. This new system will have all of the capabilities of the *Dragon Fire* – automated fire control and aiming, 6400-mil capability, sensor-to-shooter connectivity – but will incorporate the "lessons learned" from experimentation to be a better system. The EFTD V2 will be around 3,000 pounds instead of the 6,500 pounds of the present system, and it will be able to fire for longer periods on its internal batteries through more efficient technologies.

Modular Firing System. The EFTD V2 will also have the capability of uploading onto a modified Light Armored Vehicle (LAV) to become a self-propelled fire support system. This will enable the EFTD V2 to support both the Vertical Assault Element of the Expeditionary Maneuver Forces as a helicopter-mobile system as well as light armored maneuver forces.

In Stride Fire Support. In parallel with the development of an LAV modular capability of the EFTD V2, the aiming system of the weapon will be used to stabilize the tube while the vehicle is moving. This "fire on the move" capability will give the MAGTF the capability to attack targets without having to stop and interrupt the momentum of a maneuver force.

The high water speed and firepower of the Advanced Amphibious Assault Vehicle will support expeditionary force by providing an amphibious *break through* or assault force, creating the necessary penetration points along the littoral defenses.

The near term production of the MV-22 and far term production of the MAGTF Family of Fighting Vehicles (MEFFV), future replacement for the LAV and M-1 tank fleets, will invite an opportunity to equip the MAGTFs with technologies to operate consistently at operational distances once that littoral penetration is achieved

Aviation's Increasing Role in Maneuver

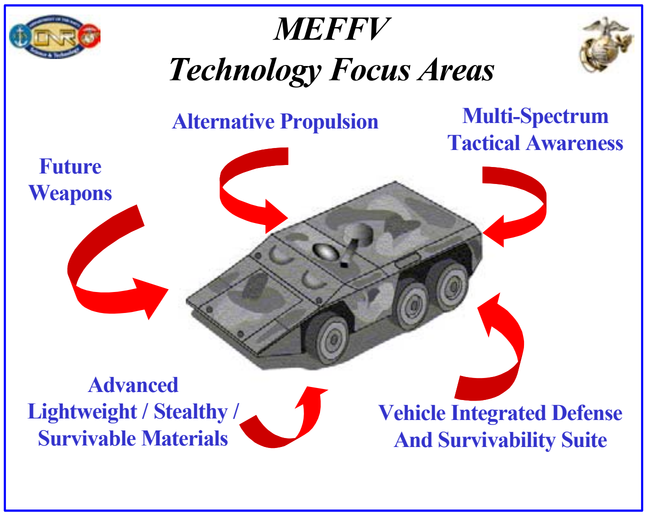
Recognizing the destructiveness and flexibility of air power, the MAGTF will no doubt possess a capability to conduct *STOM* by air, combining seabased air and missile strike operations with seabased air assault.

The greater challenge will be to create a seabased air-ground combined arms force capable of elevating the combined arms dilemma for the enemy from the tactical to the operational level. Designing an air-ground combined-arms force to adeptly accomplish the mobile force role envisioned by Marine Corps *transformation* efforts continues.

The role of air in maneuver will continue to be weighed by both the Marine Corps and the Army over the next 10 years. Air Combat Element capabilities provide the MAGTF a unique advantage in this area and their unique contributions to maneuver will be examined in maneuver concept exploration initiatives.

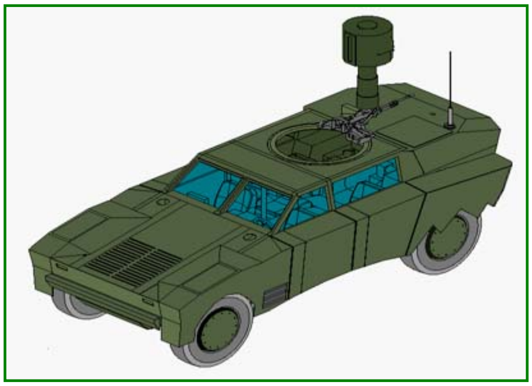
Advanced Mobility Vehicles

Primarily through wargaming, the Lab is exploring various types of future combat vehicles for employment during seabased operations. Two of the more significant are the MEFFV and RSTAV. The MAGTF Expeditionary Family of Fighting Vehicles (MEEFV) Program has initiated early activities to support design of a vehicle family for the mobile combined arms MAGTF.



Reconnaissance, Surveillance, Target Acquisition Vehicle Program (RSTV)
The RSTV Program is a jointly sponsored DARPA/ONR technology demonstrator established to build a MV-22 transportable, hybrid-electric powered, mobile RSTA suite with advanced survivability features.

The Lab in conjunction with ONR will continue to examine the roles of the RSTV in the air maneuver element of the *STOM* force.



RSTV Concept Vehicle

Other Maneuver Technology Areas

The Lab continues to look for opportunities to collaboratively work with ONR to examine technologies supporting maneuver through several other initiatives. These include:

- Integration of autonomous systems into the operating forces.
- Employment of commercial off the shelf expeditionary engineering equipment.
- Enhanced mine detection technologies and neutralization means.
- Predictive diagnostics to reduce logistic requirements ashore.
- Expanded use of modeling and simulation to support development of future maneuver and mobility systems.